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(54) Abstract Title

Resilient mounting for an axially moveable brake disc

(57) Method and apparatus for mounting a brake disc (12) in a spot-type automotive disc brake (10) in which resilient means comprising leaf springs (30, 32, 34, 36) acting between the brake disc (12) and a rotatable mounting hub (14) therefor is mounted on said hub by means of mounting tabs or tags (58) , one for each leaf spring, and adapted to lie in recesses (54) in the side face of the rotatable mounting hub (14) and having end openings (56) in which one of the wheel mounting studs (42, 44, 46, 48) is received whereby, in use, the mounting of the road wheel on the studs (42, 44, 46, 48) effectively clamps the springs (30, 32, 34, 36) in their working positions, thereby eliminating the need for any other means of securing of fastening the springs (30, 32, 34, 36) in place.

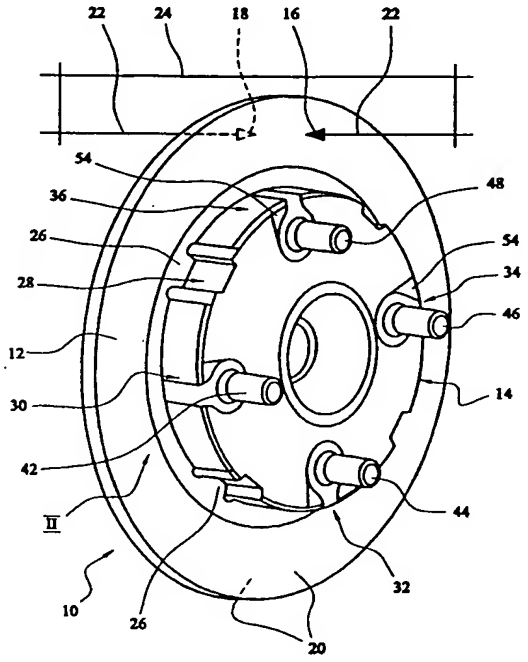

FIG. 1

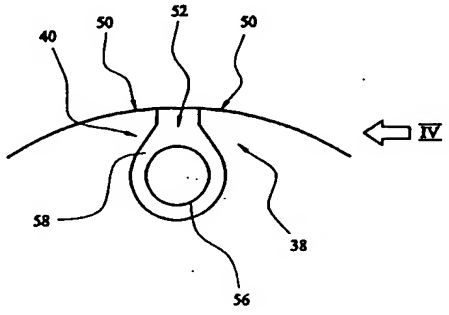

FIG. 3

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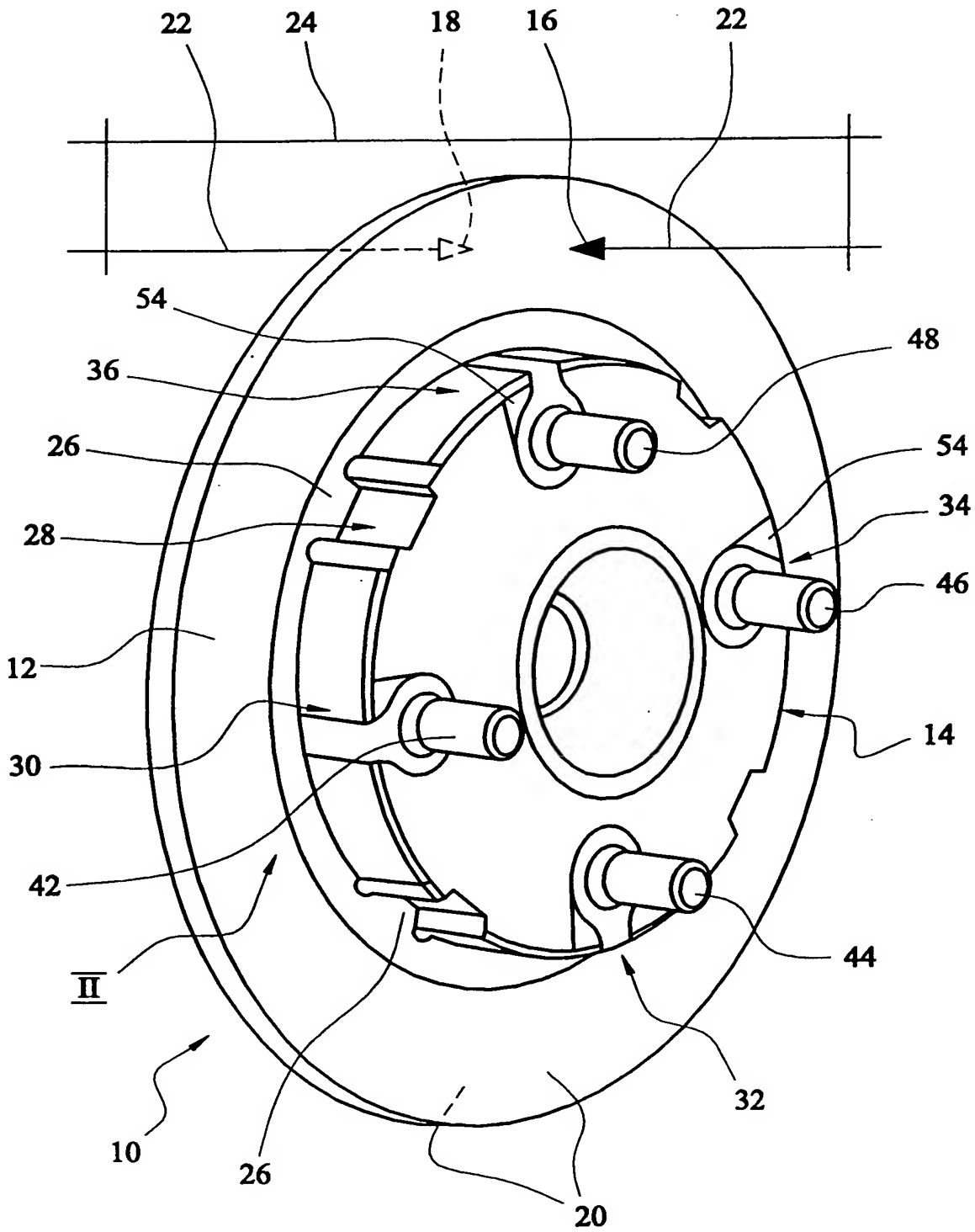

FIG. 1

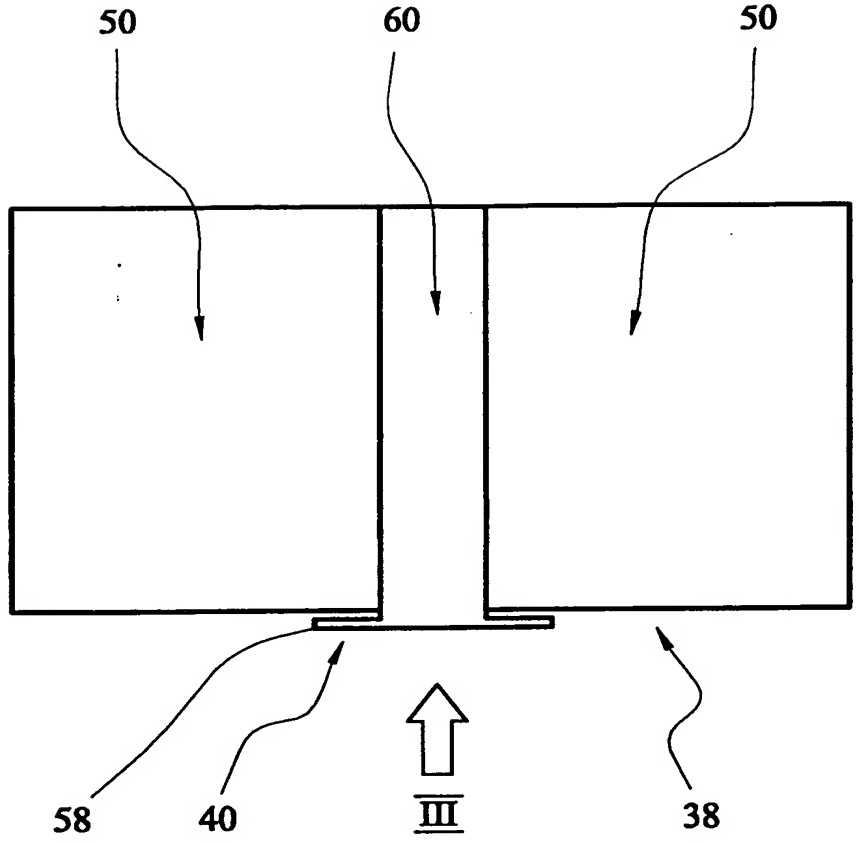

FIG. 2

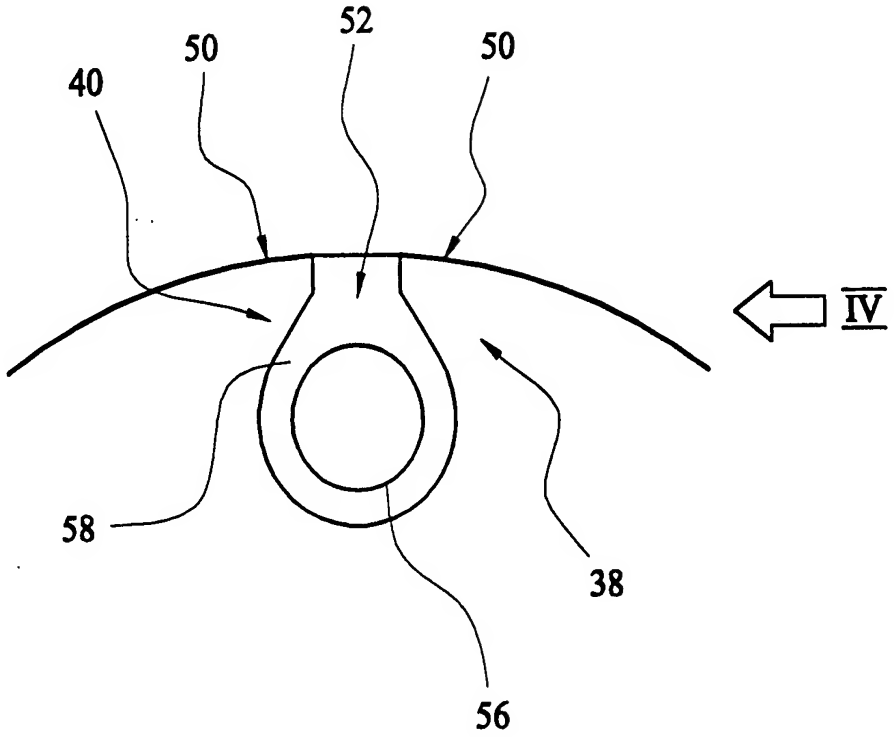

FIG. 3

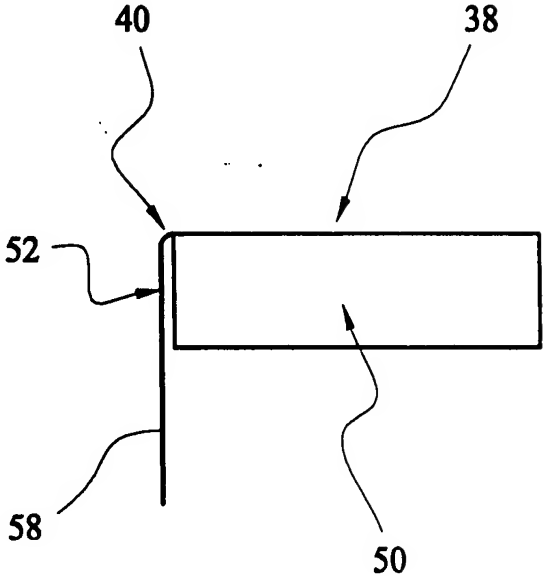

FIG. 4

METHOD AND APPARATUS FOR MOUNTING A BRAKE DISC

This invention relates to a method and apparatus for mounting a brake disc in a disc brake. A particular application of the invention is to a spot-type automotive disc brake in which at least one, and preferably two brake discs are mounted for axial movement in use with respect to a central drive hub which drives the discs and on which they exert a braking effect during use. Typically, the central drive hub is a wheel mounting of an automobile. Certain aspects of the invention may find application outside the confines of spot-type automotive disc brakes. We have established that spot-type single or multi-disc brakes of the kind comprising axially moveable discs can provide significant advantages over conventional spot-type automotive disc brakes. These advantages relate particularly, but not exclusively to dynamic aspects of the performance of the brakes as compared with conventional fixed-disc automotive disc brakes.

One aspect of these constructional differences relates to the use of resilient means acting between the one or more brake discs and the rotatable mounting therefor, such resilient means being provided to control certain aspects of the dynamics or movement of the brake discs during use. We have considered providing a disc brake system in which a plurality of leaf springs mounted on a hub and engaging the brake disc apply radially-directed forces between the disc and the hub.

An example of a prior brake proposal which incorporates such springs between the disc and hub is disclosed in our published application WO 98/25804 (docket 2561) and WO 98/26192 (docket 2558).

However, we have discovered that the mode of mounting the resilient means with respect to the drive hub is of significance in relation to the effective operation of the resilient means for the brake as a whole, not to mention the resilient function itself.

As a matter of straightforward mechanical design, the use of threaded fasteners (such as cap screws) for mounting the resilient means, for example a leaf spring represents a straightforward approach to the mounting of the springs. However, this approach involves, in practice, some complications and cost in terms of the provision of the drilled and tapped openings to receive the cap screws, not to mention the fact that such an approach involves a multiplication of the number of components with attendant assembly complications during manufacture.

However, we have discovered that despite the fact that the straightforward design approach may be argued to favour the adoption of individual fasteners cooperating with drilled and tapped recesses, there are significant and unexpected compensatory advantages in adopting a different approach in which the spring structure is adapted to operate or cooperate in two dimensionally-distinct planes for resilient bias purposes and for mounting purposes.

According to the invention there is provided a method and apparatus as defined in the accompanying claims.

In the embodiments of the invention described below the resilient means for biassing the brake disc or discs is mounted on the axially fixed rotatable mounting hub for the slidable brake disc or discs. In one embodiment the several springs (for each disc) are each adapted to cooperate with

clamping forces which act in a direction which is dimensionally distinct from the plane in which the spring forces themselves act. Thus, for example, the spring forces themselves act generally in the radial plane of the disc (being generally outwardly directed as between the hub and the disc itself), whereas the forces acting to clamp or hold the spring in place are generally directed axially with respect to the hub or disc mounting.

In the preferred embodiment, the arrangement is such that each spring incorporates structure, for example a tag or tab adapted to lie against a radially-facing side face of the hub, so as to be conveniently held or clamped between the hub and a wheel mounted thereon.

In one particularly advantageous illustrated embodiment, the tags or tabs provided on the springs are formed integrally with a main leaf portion of the spring in each case in the mid-region thereof intermediate the leaf spring ends and lying (when in use) flat against the side face of the hub, preferably located within a recess or rebate formed within the hub. By matching the gauge of the tag or tab on the spring to the depth of the rebate or recess, there can be achieved an arrangement in which the secure mounting of the spring is complemented by the maintenance of full contact between the hub and the road wheel to be mounted thereon.

By the adoption of an arrangement in which the spring mounting is adapted to cooperate with forces acting in a direction dimensionally distinct (generally axially with respect to the disc) from the plane in which the spring forces themselves act (in the plane of the disc) the advantage is achieved of a simple and cost effective mounting taking advantage of the structure of the hub and

able to be secured thereto by means of the wheel-mounting arrangements thereon, such as wheel studs.

It will be appreciated that the commonplace arrangement for wheel mounting purposes adopts projecting threaded studs on the wheel-mounting hub to be received in correspondingly-spaced and proportioned apertures, usually on a common pitch circle, formed in the wheel. The spring tags or tabs may be constructed to cooperate with this mounting system by, for example, being formed with apertures(typically one for each tag or tab and corresponding to the aperture in the road wheel rim therefor), so that the tag or tab can be received on the wheel mounting stud. In a simplified format the tag or tab may be merely provided with a slot proportioned to receive the stud at the thus-bifurcated tag or tab end for location purposes.

In its undeflected condition the resilient means for the disc (when in leaf spring format) is typically a linear leaf spring which is deflected into arcuate form on assembly, thereby generating the resilient effect required for its disc biassing function. Thus, in this unstressed format, the structure of the leaf spring comprises two integral metallic strip-format elements of spring sheet steel lying in planes generally at right angles. The simplicity of construction is evident. The simplicity of mounting follows from this. Of course, the tags or tabs need not be formed integrally from spring steel though usually this will be convenient and economic. A fabricated construction could of course be adopted.

The avoidance of the need for the provision of additional drilled and tapped mounting holes for fasteners such as cap screws represents a simplification and cost-effective design feature.

In short, it will be appreciated from the embodiments that there has been provided a simple spring arrangement for resilient loading of axially-slidable brake discs, particularly (but not exclusively) for automotive use in which the simplicity of structure and assembly derives from a structural relationship with the available elements of the wheel-mounting and brake structure thereby eliminating the need for the use of additional mounting elements such as fasteners and attendant requirements for cost-incurring additional manufacturing steps.

It will be apparent from the foregoing that the competent technical worker in the field may be able to devise spring elements in a different format, for example wire springs, which are able to derive related advantages from the features discussed above. Thus a wire spring might well be locatable with respect to a wheel stud while having a form in which a portion corresponding to the tag or tab portion of the above embodiment (perhaps provided by twin wires) is provided with a radially outer spring-force-applying portion adapted to engage the disc and apply resiliently-generated loads thereto in a manner comparable to that of its leaf spring counterpart.

It needs also to be noted that the resilient means adopted in the embodiments of the present invention have a resilient effect and generate a corresponding spring force which is of a magnitude such that it is significantly greater than that which is required merely for elimination of rattle, and a distinction is therefore to be drawn between the resilient means of the embodiments of the present invention and previously proposed anti-rattle springs in brakes of various kinds. The spring forces generated in the embodiments of the present invention are at a level such that the friction elements are constrained (by the predetermined spring

forces) from sliding on their guides, whereby not only is rattling or noise suppression achieved but also the friction elements are restrained from free sliding movement into contact with the brake discs in an uncontrolled manner.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a perspective view of a rotatable brake disc and a corresponding rotatable mounting for the disc and forming part of a spot-type automotive disc brake assembly;

Figure 2 shows, on a larger scale, a plan view of resilient means in the form of a leaf spring assembly forming part of the disc brake assembly of Fig 1, the direction of viewing being generally as indicated by arrow II in Fig 1;

Figure 3 shows a side elevation view of the resilient means of Fig 2 in its deflected (and resilient force-generating) attitude, the direction of viewing being generally as indicated by arrow III in Fig 2; and

Figure 4 shows, also on an enlarged scale, a further view of the leaf spring of Figs 2 and 3, the direction of viewing being indicated by arrow IV in Fig 3.

As shown in Fig 1, a spot-type automotive disc brake 10 comprises at least one rotatable brake disc 12 and a rotatable mounting 14 and which is adapted to drive the disc 12 and to have exerted thereon a braking effect by the brake

disc when the disc brake is actuated.

In this embodiment, only one brake disc is shown, but it is to be understood that little modification is needed for the adoption of two or more brake discs corresponding to disc 12, such requiring mainly the provision of an additional double-sided friction element between the pair of brake discs, in addition to the pair of friction elements described below. The resilient means described below for the single brake disc 12 can be readily constructed so as to be of sufficient width (measured in the axial direction with respect to the disc) so as to act simultaneously on both brake discs.

The technically competent worker in the field will be capable of making the corresponding related design modifications (needed for the adoption of twin discs) without substantial difficulty.

At least one pair of friction elements 16, 18, which are adapted to frictionally engage braking surfaces 20 on opposite sides of brake disc 12 are provided to effect braking on actuation of actuating means 22 therefor.

In Fig 1 friction elements 16 and 18 have been indicated purely diagrammatically in terms of arrow heads indicating the approximate location at which the friction elements engage the braking surfaces 20 of disc 12. Likewise, actuation means 22 has been correspondingly indicated in terms of the arrow shafts of arrow heads 16, 18 on the basis that the actuation means acts generally in the directions indicated, employing a hydraulic cylinder at one side of the disc brake assembly which acts in the axial direction to force the friction elements and brake disc or discs into frictional engagement at a position defined by an axial stop

provided by a fixed caliper indicated at 24.

Brake disc 12 is axially slidable in use with respect to mounting hub 14 therefor under the action of friction element 16, 18 and actuation means 22 during braking. As shown in Fig 1, disc 12 comprises inwardly-projecting dogs or keys 26 which drivingly engage keyways 28 formed in mounting or hub 14 so as to transmit drive while being axially slidable.

Resilient means 30, 32, 34, 36 are provided at positions around brake disc 12 and adapted to act between the brake disc and mounting 14 therefor. Each resilient means 30 to 36 comprises a leaf spring 38 assembly as shown in Figs 2 to 4, and to be described more fully below.

Each of the resilient means 30 to 36 comprises mounting means 40 adapted to mount the resilient means at a position around the brake disc and which permits the resilient means when so mounted not only to apply a resilient bias to brake disc 12, such bias acting generally in the plane of the disc, but simultaneously the mounting means enables the resilient means to cooperate with clamping means acting generally in an axial direction with respect to the brake disc, and provided by a wheel-mounting stud. Four such studs 42, 44, 46, 48 are being provided in the usual way to receive the correspondingly-apertured roadwheel of a vehicle. Studs 42 to 48 are threaded in the usual way to receive wheel nuts (not shown).

Each of the resilient means 32 to 36 comprises a main spring portion 50 in the form of a generally linear leaf spring, which is adapted to cooperate with the inner edge surface of brake disc 12, and a mounting portion 52 which is adapted to lie alongside an axially-facing side face of mounting or hub

14. In each case there is provided a forged-in recess or rebate 54 to receive mounting portion 52 when assembly takes place.

As shown in Fig 3, mounting portion 52 is adapted to cooperate with its respective one of wheel mounting studs 42 to 48 by being formed with a correspondingly-proportioned stud-receiving opening 56 whereby, in use, the mounting portion 52 of leaf spring assembly 38 is clamped in its respective rebate 54 by the combined effect of studs 42 to 48, their associated wheel nuts, and the corresponding roadwheel disc.

It can be seen in Figs 1 and 2 of the drawings that mounting portion 52 of each leaf spring assembly 38 comprises not only a radially inwardly-extending flat tab portion 58 but an integral linear strip portion 60 extending axially (with respect to disc 12) across the width of main spring portion 50 and forming an integral structure therewith.

In use, resilient means 30 to 36 exert their resilient outward bias on brake disc 12, controlling the axial movement thereof under the conditions of use of the brake in accordance with the requirements of the operating parameters for sliding disc spot-type automotive disc brakes.

It will be appreciated by those skilled in the art that further embodiments and arrangements in accordance with the general principles of the invention are possible. For example, the resilient means could extend over a larger arc and circumferential portion of the hub and could include additional mounting portions which are mounted on adjacent or successive studs. In other words, the resilient means may be supported from two or more studs. Likewise, the resilient means could comprise a single spring extending around the

entire circumference of the hub and located via a number of mounting portions onto a number, or all, of the studs. In the case of a single spring member or other enlarged spring which extends into the region of the disc dogs 26 (which engage the hub 14), cut-outs or apertures would be provided to accommodate the dogs and to allow these to engage the hub 14. A particularly advantageous arrangement is for a pair of resilient springs to be used, each of which extends around half of the hub's circumference. Each such spring would be mounted and supported from the hub by at least one and preferably more than one, of the studs. In yet further embodiments, similar to the embodiments shown, the mounting portions 58 could be connected or formed as a single common mounting unit serving a number of separately operable springs. By using such a single common mounting unit, assembly would be made easier and the number of separate parts reduced.

Although the embodiments shown have four springs 30 to 36 and studs 44 to 48, it will be readily apparent that a larger or smaller number of springs 30 to 36 and/or studs 44 to 48 could be used.

CLAIMS

1. A method of mounting a brake disc in a spot-type automotive disc brake, the disc brake comprising:-

a) at least one rotatable disc;

b) a rotatable mounting for said brake disc to permit such rotation and which is adapted to drive said brake disc and to have exerted thereon a braking effect by said brake disc when the disc brake is actuated;

c) at least one pair of friction elements adapted to frictionally engage braking surfaces on opposite sides of said brake disc to effect braking on actuation of actuation means therefor;

d) said brake disc being axially slidable in use with respect to said mounting therefor under the action of said friction elements and said actuation means therefor during braking'

e) resilient means being provided at positions around said brake disc and adapted to act between said brake disc and said mounting therefor;

characterised by said method comprising:

f) providing said resilient means comprising mounting means therefor adapted to mount said resilient means at said positions around said brake disc, and causing said resilient means when so mounted to apply a resilient bias to said disc generally in the plane of said disc while said mounting means cooperates with clamping means acting generally in an axial direction with respect to said disc.

2. A method of mounting a brake disc in a disc brake comprising providing resilient means adapted to act between said brake disc and a rotatable mounting therefor at positions around said disc, and providing mounting means for said resilient means, and the method comprising causing said

resilient means to apply a resilient bias to said disc while said resilient means also provides mounting means for said resilient means which cooperates with clamping means acting generally in the axial direction with respect to said disc.

3. A method according to claim 1 or claim 2 characterised by providing said resilient means comprising a main spring portion adapted to cooperate with said disc and a mounting portion adapted to lie alongside an axially-facing side face of said rotatable mounting for said disc.

4. A method according to claim 3 characterised by causing said mounting portion of said resilient means to cooperate with a wheel mounting stud on said rotatable mounting for said brake disc.

5. A method according to claim 4 characterised by causing said mounting portion to cooperate with said wheel mounting stud by means of an end opening formed in said mounting portion of said spring.

6. A method of mounting a brake disc in a spot-type automotive disc brake substantially as subscribed herein with reference to the accompanying drawings.

7. A spot-type automotive disc brake, the disc brake comprising:-

a) at least one rotatable disc;

b) a rotatable mounting for said brake disc to permit such rotation and which is adapted to drive said brake disc and to have exerted thereon a braking effect by said brake disc when the disc brake is actuated;

c) at least one pair of friction elements adapted to frictionally engage braking surfaces on opposite sides of said brake disc to effect braking on actuation of actuation

means therefor;

d) said brake disc being axially slidable in use with respect to said mounting therefor under the action of said friction elements and said actuation means therefor during braking'

e) resilient mean being provided at positions around said brake disc and adapted to act between said brake disc and said mounting therefor;

characterised by

f) said resilient means comprising mounting means therefor adapted to mount said resilient means at said positions around said brake disc, and said resilient means when so mounted being adapted to apply a resilient bias to said disc generally in the plane of said disc while said mounting means cooperates with clamping means acting generally in an axial direction with respect to said disc.

8. A disc brake comprising resilient means adapted to act between a brake disc and a rotatable mounting therefor at positions around said disc, and mounting means for said resilient means, and the said resilient means being adapted to apply a resilient bias to said disc while said resilient means also provides mounting means for said resilient means which cooperates with clamping means acting generally in the axial direction with respect to said disc.

9. A brake according to claim 7 or claim 8 characterised by said resilient means comprising a main spring portion adapted to cooperate with said disc and a mounting portion adapted to lie longside an axially-facing side face of said rotatable mounting for said disc.

10. A brake according to claim 9 characterised by said mounting portion being adapted to cooperate with a wheel

mounting stud on said rotatable mounting for said brake disc.

11. A brake according to claim 9 characterised by said mounting portion being adapted to cooperate with said wheel mounting stud by means of an end opening formed in said mounting portion of said spring.

12. A spot-type automotive disc brake substantially as subscribed herein with reference to the accompanying drawings.

13. Resilient means adapted for use in a disc brake according to any one of claims 7 to 12.

14. Resilient means adapted for use in accordance with a method according to any one of claims 1 to 6.

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Application No: GB 0010804.3
Claims searched: 1-14

Examiner: David McWilliams
Date of search: 16 September 2000

Patents Act 1977
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Int Cl (Ed.7): F16D 65/12

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Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
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